

WATSON (B.A.) *Compliments of the Author.*

THE
PATHOLOGY AND TREATMENT
OF
CHRONIC ULCERS.

BY

B. A. WATSON, M. D.,

SURGEON TO JERSEY CITY CHARITY AND ST. FRANCIS'S HOSPITALS.

[REPRINTED FROM THE NEW YORK MEDICAL JOURNAL, JULY, 1875.]



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THE PATHOLOGY AND TREATMENT OF CHRONIC ULCERS.

THE study of the pathology of chronic ulcers necessarily involves a brief consideration of the origin and characteristics of that class usually designated as acute, since the former differ from the latter in so slight a degree as to render it frequently difficult to determine satisfactorily where the one ends and the other begins. Acute ulcers frequently become chronic, and chronic occasionally acute. Whether an ulcer becomes chronic or not, frequently depends upon its size, location, the condition of the patient's general health, and the presence or absence of local irritation. We often see large chronic ulcers situated on the upper extremities and various parts of the body, which have resulted from deep and extensive burns; but the smaller ulcers thus favorably situated usually heal without reaching the chronic stage, unless the patient's health has been previously vitiated. Local irritation, unaided by other influences, seldom produces the characteristic chronic ulcer on other parts of the body than the leg, and when thus situated the proper management requires much skill and considerable patience.

“ Few practitioners look upon this class of diseases in the true light of philosophy; their ideas of their pathology are vague and indistinct; and it is not, therefore, surprising that they should find themselves completely baffled in their efforts at curing them. It is for this reason that chronic ulcers of the legs have so long been regarded as an opprobrium of surgery, and that so many patients are obliged to carry their malady with them to the grave, notwithstanding the numerous attempts that may have been made to get rid of it; all

arising from the fact that its true nature was never properly understood.”¹

That we may better comprehend the nature of chronic ulcers, and thereby be more successful in their treatment, it will be necessary for us to begin the investigation with the pathological changes in the parts immediately preceding their formation.

“The first change that we see in irritated living tissue is dilatation of the vessels; the immediate result of this is retardation of the flow of blood, increased transudation and a collection of white blood-cells in the periphery of the calibre of the vessels, the wall of the vessels gradually grows softer, possibly from the long contact with the white blood-cells, which gradually enter and finally pass through the walls.”²

Following this condition and dependent on it are the infiltration of the tissues and defective nutrition of the parts. These changes may be the result of local injury or constitutional disease. The local injury may be mechanical or chemical. The constitutional disease may be specific or general. The infiltration is caused by the escape of “wandering white blood-cells through the walls of the vessels, their collection in the tissue, with the secondary action they induce: plastic infiltration, and inflammatory new formation.”³

The defective nutrition of the parts in cases of local injury may be primarily due to the destruction of the capillary vessels, or, as in cases of constitutional diseases, may depend upon the infiltration and resulting hyperæmic condition of vessels. When the local injury has been sufficiently severe, a larger or smaller portion of integument will be ultimately thrown off as a slough, with more or less of the adjacent tissues, leaving a granulating wound or ulcer, but in other cases, where the injury has been less severe, there will be only an abrasion or excoriation of the skin, possibly infiltration into the cellular tissue, which may be followed by the formation of an abscess, and finally result in the destruction of the integument. In the former case the ulcer commences on the surface, and in

¹ Gross’s “System of Surgery,” vol. i., p. 184.

² Billroth’s “Surgical Pathology,” p. 60. ³ *Ibid.*, p. 68.

the latter the abscess ends in the transformation process. In cases of constitutional disease, not unfrequently the first intimation that an ulcer is in the process of formation is gained in the discovery of a vesicle or pustule, which only needs to be opened to convert it into a miniature ulcer, which then often increases rapidly in size. It is a well-established fact that the wandering white blood-cells in the tissue are followed by plastic infiltration and inflammation, and the tissue in which these cells are infiltrated dies, as always happens in circumscribed cell-proliferation. The tissue surrounding the spot first diseased is gradually infiltrated with cells; and it also goes on to form fluid cellular tissue with the character of pus; the infiltrated tissue is the more disposed to suppurate and break down when its vessels are little developed and do not supply sufficient qualitative or quantitative nutriment material to maintain the further development of the excession-cells.”¹

The origin and action of pus in this connection is worthy of our brief consideration. Pus was formerly supposed to possess solvent properties; but it is now known that “*pus is not the dissolving, but the dissolved, i. e., the transformed tissue.* A part becomes soft, and liquefies while suppurating, but it is not the pus which occasions this softening; on the contrary, it is the pus which is produced as the result of the proliferation of the tissue.”²

Paget believes that inflammatory lymph is readily converted into pus, and in fact that this is its usual origin. Billroth says: “Pus is fluid, as it were melted, dissolved inflammatory new formation. When pus is present in quantity, it must have come from some sort of granulation tissue, or from some other highly-vascular and usually highly-cellular source; this source need not always be a surface, as in the present case, but may lie deep in the tissue and form a cavity; the centre of an inflammatory new formation anywhere in the tissue may break down into pus.”³

Wandering cells as we see have already played a very im-

¹ Billroth’s “Surgical Pathology,” p. 368.

² Virchow’s “Cellular Pathology,” p. 490.

³ Billroth’s “Surgical Pathology,” p. 69.

portant part in the inflammatory action and pus-formation ; but this seems to be only a secondary and minor part of their work. The formation of granulation tissue, or the healing of wounds by the granulation process, is only an example of the proliferation and transformation of the wandering cells. "That is, the white blood-cells become fixed connective-tissue cells."¹ The formation of granulations on the surface of a wound is preceded by an exudation of lymph ; or a fibrinous substance which, if the wound be left open, will be found to cover its entire surface, glazing it over with a whitish film ; "and this, if it be examined with the microscope, will be found to contain an abundance of corpuscles having the appearance of white corpuscles of the blood."²

Billroth says : "The exuded fibrinous material on the surface of the wound becomes soft and gelatinous ; at the same time, the infiltrated tissue of the surface of the wound assumes the same peculiarities ; the soft connective tissue, into which the young vessels shortly grow, even if only present in small quantities, holds together the cells of inflammatory new formation, which constantly increase in numbers. The *granulation tissue* is thus formed."³

In the large majority of ulcers of recent formation, the first granulations which form are healthy, and possess the power of reproduction in a high degree ; but this power is gradually diminished until the granulations are no longer capable of reproducing their kind. The surgeon may be still able to urge forward after some delay the granulation process, but in this class of cases the improvement is often only temporary, and, sooner or later, the newly-formed cells begin to melt away, when their destruction is much more rapid than had been their growth. The loss of this power is due primarily to defective nutrition in the parts, and the inclination is to secure a freer development of vessels and thereby stronger cells, "which do not lead to suppuration, but to connective-tissue new formation."⁴

¹ Billroth's "Surgical Pathology," p. 61.

² Paget's "Surgical Pathology," p. 15.

³ Billroth's "Surgical Pathology," p. 68.

⁴ *Ibid.*, p. 395.

The transformation of the acute ulcer into the chronic may be rapid or slow. Some ulcers are essentially chronic from their commencement, especially in cases of constitutional disease. Chronic ulcers also differ widely in their characteristics, and have received a great variety of appellations, according to their peculiarities. I shall attempt to enumerate them only so far as their varied pathological character would seem to serve as an indication to their proper management. Cancerous and lupoid ulcers, although sufficiently chronic, are not included here—belonging more properly to another classification—and for the additional reason that the treatment in these diseases differs in a marked degree from that of the ordinary chronic ulcer.

It may be advantageous in the study of this subject to recall to mind the fact that chronic ulcers may originate either in constitutional disease, local irritation, or both; and the same influences that have caused their origin may perpetuate their existence. The nomenclature of ulcers, it must be confessed, is still vague and unsatisfactory, although to some extent based on local conditions and constitutional diseases. The following names, more frequently applied to chronic ulcers than acute, as callous, varicose, irritable, inflammatory phagedenic, and exuberant, are founded on certain peculiarities or morbid conditions of the ulcer, or the parts more or less immediately surrounding it; while others, also essentially chronic, but originating in constitutional disease, are designated as syphilitic, strumous, eczematous, and scorbutic. These names, although apparently sufficiently explicit, are nevertheless frequently unsatisfactory to the surgeon, for the reason that few ulcers are seen in practice which do not possess a mixed character. The varicose, like the callous ulcer, frequently has a hardened border and base. The induration is occasionally so great as to render these parts as firm as cartilage, and this hardness seriously interferes with the necessary flow of blood to the ulcer, which now becomes torpid in character. The inflammatory ulcer may possess the characteristics of the irritable, and under these circumstances resemble both. The tertiary syphilitic ulcer is often found on the leg, complicated with the varicose condition. The phagedenic ulcer under

proper management may soon lose its peculiarities on which the name is based ; and the same remark applies with equal force to a large portion of the names now in common use. The names are expressive of certain conditions, often transient in character, rather than of any specific class of lesions ; and a consideration of these facts suggests the propriety of adhering as closely as possible to the primary division of ulcers into idiopathic and symptomatic, or acute and chronic. "Idiopathic ulcers are such as result from purely local irritation ; they may also be termed irritative ulcers. Symptomatic ulcers are such as from some dyscrasia appear as a symptom of constitutional disease, without the action of a local irritation on the affected part."¹ An acute ulcer is one in which the recuperative action preponderates over the process of disintegration. A chronic ulcer is one in which the process of disintegration is *equal to*, or *greater than*, the recuperative action. The terms acute and chronic are used here to express a *condition*, without reference to the time which has elapsed since the formation of the ulcer, but with a bearing on the probable duration. It therefore follows as a natural sequence that so long as an ulcer remains acute the treatment is comparatively of little importance ; but the chronic ulcer requires for its successful management a thorough knowledge of its pathology ; the power and adaptability of the remedial agents which are to be employed ; and, finally, much skill in the application of the same. I have not attempted to describe the varied appearances of the chronic ulcer, which would require much time and space—a repetition of an almost endless catalogue of names—a detail of the form, shape, color, size, location, character of the discharges, and the surrounding conditions, but have given considerable attention to its origin—have also alluded to some of its subdivisions, and finally offered a definition. It is not my intention now to enter into the details of treatment, but I shall first attempt to inquire into the indications, then offer a few suggestions on their general management, and finally conclude with a description of that method which will enable us, I believe, to accomplish the object sought, in the least possible time, in the greatest number

¹ Billroth's "Surgical Pathology," p. 395.

ber of cases. Ulcers originating in constitutional diseases furnish us a reliable indication for the constitutional treatment, and, should this indication be disregarded, failure instead of success may be confidently anticipated. It is also true that the constitutional treatment, although absolutely necessary in these cases, will result disastrously if unaided by local applications and the successful management of all existing complications. Thus the tertiary syphilitic ulcer will require that the patient should receive constitutional treatment.

Iodide of potassium, either alone or in combination with tonics, will be found not only advantageous, but often indispensable. The existing condition of the ulcer must be your guide for the local treatment. Should its base and border be found firmly indurated, or the ulcer complicated with a varicose condition of the veins of the parts, then such means should be employed as will remove the complication. In the employment of further means, it should not be forgotten that, "to induce healing of an ulcer, the first requirement is arrest of the disintegration on the surface; next, that the floor of the ulcer assumes, at least approximately, the character of a healthy granulating surface, which goes on to cicatrize in the usual way. In torpid, atonic ulcers it is absolutely necessary that there should be a free development of vessels, and stronger cells, which do not lead to suppuration, but to connective-tissue new formation; in proliferating ulcers, on the other hand, the new formation must be brought back to the normal size. As you will readily perceive, on reflection, this gives the indication for the local treatment to be followed in either case."¹ Let us now remember, in the use of remedies, the indications and requirements. Our first object is, to arrest the disintegration on the surface of the ulcer. This process of disintegration, in both the constitutional and local ulcers, is perpetuated by irritation, and to relieve this condition is the great object of treatment. How can this object be most readily accomplished? The patient in all severe cases must be kept in bed—this is the *sine qua non* of treatment; and next to this is perfect cleanliness—not merely of the ulcer, but

¹ Billroth's "Surgical Pathology," p. 395.

the whole person. Thus far nearly all chronic ulcers will be benefited by the same treatment, and a careful inspection will now furnish further indications for its proper management. Should the edges of the ulcer be indurated, inverted, or ragged—there being at the same time complete absence of healthy granulations—and a secretion of thin ichorous pus, then you should choose between the use of the knife, actual cautery, the application of caustic potash or strong nitric acid ; but, in more favorable conditions, a wet compress or an emollient poultice may be sufficient to meet the indications. It should not, however, be forgotten that *rest in bed and entire neatness* will in the course of a few days, in nearly all cases of ill-conditioned ulcers, effect an almost marvelous change for the better. The explanation of this is to be found in the fact that the position will usually put an end to nearly all local irritation, and also greatly reduce the inflammation. This, however, will not be the case when the ulcer is originated or perpetuated by dead or diseased bone, and here the sooner the irritation is removed the better it will be for the patient. With these brief allusions to the management of constitutional and local complications, I shall now enter on the consideration of the best means for the production of healthy granulations, and subsequent cicatrization of chronic ulcers. The importance of this subject demands an inquiry into the pathological conditions attending these processes ; and without this knowledge it would be impossible to understand the indications for treatment. “Hunter says: ‘I have often been able to trace the growth and vascularity of this new substance. I have seen upon a sore a white substance, exactly similar, in every visible respect, to coagulating lymph. I have not attempted to wipe it off, and the next day of dressing I have found this very substance vascular ; for by wiping or touching it with a probe it has bled freely. I have observed the same appearance on the surface of a bone that was laid bare. I once scraped off some of the external surface of a bone of the foot, to see if the surface would granulate. I remarked the following day that the surface of the bone was covered with a whitish substance, having a tinge of blue ; when I passed my probe into it, I did not feel the bone bare,

but only its resistance. I conceived this substance to be coagulating lymph thrown out from inflammation, and that it would be forced off when suppuration came on; but on the succeeding day I found it vascular, and appearing like healthy granulations."¹ This observation of Mr. Hunter's wanted only the application of the microscope to show all that is now known in regard to the formation of granulations.

Billroth, speaking of this question in connection with the treating of incised wounds, says: "What will now take place in the tissue itself? Essentially, the same changes as in the united edges of a wound; wandering of white blood-cells through the walls of the vessels, their collection in the tissue with the secondary action they induce; plastic infiltration, and inflammatory new formation. But since there is no opposing wounded surface with which the new tissue can coalesce, then to be quickly transformed to connective tissue, the cells, escaping from the vessels, remain at first on the surface of the wound; the exuded fibrinous material on the surface of the wound becomes soft and gelatinous; at the same time, the infiltrated tissue of the surface of the wound assumes the same peculiarities; the soft connective tissue, into which the young vessels shortly grow, even if present in only small quantities, holds together the cells of the inflammatory new formation, which constantly increase in number. The *granulation tissue* is thus formed; this is, therefore, a highly-vascular inflammatory new formation. At first it grows constantly, the direction of its growth being from the bottom of the wound toward the surface; the tissue is, however, of different consistence in the various layers, its superficial surface especially is soft, and *most* superficially of fluid consistence, for here the intercellular substance becomes not only gelatinous, but fluid; this uppermost thin fluid layer, which is constantly flowing and being constantly renewed from the granulation tissue by cell-exudation, is *pus*."² Having presented the subject of granulation, it now becomes necessary to give some attention to the process of cicatrization. We have already observed

¹ Paget's "Surgical Pathology," p. 155.

² Billroth's "Surgical Pathology," p. 68.

that granulation begins in the bottom of the ulcer, that layer upon layer is formed until the ulcer has been filled on its periphery to the level of the surrounding skin, at which point the cicatrization must commence. "The following metamorphoses now gradually occur: the entire surface contracts more and more, becomes smaller; on the border, between skin and granulations, the secretion of pus diminishes; first, a dry, red border, about half a line broad, forms and advances toward the centre of the wound, and, as it progresses and traverses the granular surface, it is followed closely by a bluish-white border, which passes into normal epidermis. These two seams result from the development of epidermis, which advances from the periphery toward the centre; . . . until "finally it covers the entire granulating surface."¹ It has, however, been claimed that, in a few rare instances, there are exceptions to this rule, that all cicatrization advances from the periphery toward the centre;² but Billroth disbelieves this statement, and says: "This is only true of cases where portions of cutis with rete Malpighii have remained in the midst of the wound, as may readily happen in gangrenous wounds, as the caustic agent may penetrate unequally deep. . . . But, if there be no such remnant of rete Malpighii, we never have these islands in the cicatrix; the formation of epidermis only takes place gradually, from the periphery of the wound toward the centre. I believe this so firmly, that I think surgeons, who say they have seen otherwise, must be mistaken in some way."³ My observation confirms the opinion here stated, and I shall reluctantly believe that cicatrization furnishes an exception to the general law as given by Prof. J. J. Chisholm: "A living substance possessing formative power can only produce its kind; and, under this general law of Nature, old skin alone can form new: therefore is it that islets of new skin are never seen dotting the surface of an ulcer which has extended through the entire depth of integumentary tissues."⁴ I have entered thus fully on the subject of the pathology of

¹ Billroth's "Surgical Pathology," p. 66.

² See Paget's "Surgical Pathology," p. 215.

³ Billroth's "Surgical Pathology," p. 67.

⁴ Richmond and Louisville Medical Journal, for October, 1870.

granulation and cicatrization for the purpose of aiding the rational treatment of these lesions. The well-merited high standing of the authorities cited entitles their opinions to great weight; and the important question is now, "How can the indications be best met, and the object sought accomplished in the least possible time in the greatest number of cases?" I believe that the plan introduced by M. Revardin not only enables us to heal ulcers, which otherwise would remain open and suppurating during the whole life of the patient, but at this time is *the most potent power* known to surgeons for healing all chronic ulcers. It is at the same time a question to be determined, in each and every case of this lesion, whether the advantages to be gained by this method will compensate the patient for the additional inconvenience. Many cases of small chronic ulcers, although situated on the lower extremities, have, when attended by favorable conditions, been induced to heal, while the patient continued to perform his duty as laborer or mechanic. In cases where the patient's condition forces him to attend regularly to his business, strapping over the ulcer, bandaging the limb, and occasionally other remedies, will be preferred to skin-grafting. The preference is here given to other methods, although the healing is not so readily or perfectly accomplished. I am now satisfied, after having practised skin-grafting in hospitals more than four years, during which period I have had the opportunity of witnessing the application of this method to the healing of a large number of chronic ulcers, and comparing it with the other methods now in use for the accomplishment of the same object, that the following are some of the advantages which may be safely claimed for it: It enables us to heal chronic ulcers which otherwise would go with the patient to his grave; to heal others which have resulted from extensive burns and complete destruction of the integument over a large surface of the body, with a rapidity formerly unknown; and also that it produces a more healthy cicatrix, and prevents, to a very great extent, the deformities which otherwise would exist. The fact that the application of a few skin-grafts to an ulcer usually produces an improved condition—a vitalizing effect—I think will be readily admitted by those who have

watched the operation; but the larger the number applied, the better the results obtained. The ulcer is, I believe, temporarily improved, even though the grafts fail to become adherent, but the most marked improvement is seen in cases where a large number of points of cicatrization have formed. "Dr. Masters states, on the authority of Mr. Rivers, that an unhealthy or feeble stock has been restored to health by the imposition of a healthy graft. This fact has its parallel in what takes place after the surgical operation of grafting a bit of healthy skin upon an ulcerated surface."¹

In regard to the effect of the healthy graft on the unhealthy stock of plants, I am unable to speak from my own observation; but, in cases of skin-grafting in ulcers, I know that the unhealthy ulcer is frequently transformed into the healthy with surprising rapidity. I now recall to mind a case in which nearly all the other methods known in surgery had been applied unsuccessfully for the healing of a very large ulcer, which extended from the axilla to the crest of the ilium, on which I applied two hundred skin-grafts, and had the satisfaction of seeing the patient discharged, cured, from the hospital within six weeks. The patient had been in the hospital, at the time of the application, many months, with no permanent improvement. Among other means attempted for his relief was the performance of a plastic operation, whereby a large portion of the ulcer was sought to be covered by healthy integument, cut from the adjacent parts. This operation completely failed, and resulted in an increase of the size of the ulcer. Skin-grafting not only rapidly healed it, but produced a firm cicatrix without deformity, and in which there was very little tension. The rapidity of the reparative process is apparently due in the first instance to the vitalizing effects of the grafts upon the granulations, whereby they are enabled to reproduce themselves with a rapidity very rarely seen, except as a sequel of this method; and, secondly, to the formation of a large number of new points of cicatrization, which rapidly increase in size, while cicatrization at the periphery of the ulcer is also very much hastened. I am now satisfied, after an extensive and pro-

¹ Ross, "Graft Theory of Disease" p. 41.

longed trial of the different methods of skin-grafting, that the use of small portions of healthy integument is far preferable to the epidermic scales or lymph. The results are much more uniform and certain. I prefer small portions of integument to large ones, and believe that our greater success with the former is due largely to the fact that these are more readily kept in actual contact with the surface of the ulcer, than the latter. The larger portions of integument are liable to be raised from the surface of the ulcer by the formation of pus beneath them. I do not claim to understand perfectly all of the conditions essential to successful skin-grafting; but I am fully satisfied, and my experience justifies the conclusion, that *perfect cleanliness* of the ulcer is more important than any thing else. Every particle of dead tissue *must be removed*. Should the smallest particle intervene between the graft and the surface of the ulcer, failure instead of success may be confidently anticipated. This one condition being constantly kept in mind, and fully attained, the surgeon may then apply grafts to chronic ulcers, whether of constitutional or local origin, with the assurance that at least seven²five per cent. of all those applied will become adherent, and form new points of cicatrization. I am accustomed to secure the required cleanliness by the use of the caustics, emollient poultices, and wet compresses. It often requires eight or ten days to prepare the ulcer for the reception of the grafts; and during the preparation I prefer to have my patient kept in bed, for reasons previously mentioned. Although a very careful preparation is absolutely essential to success, nevertheless the proper application of the grafts is of equal importance. In speaking of this operation, for the sake of brevity, I shall omit many of the important steps which have been previously detailed in the various articles already published on this subject, and content myself with mentioning certain details and peculiarities of treatment which I have found to be advantageous. I am in the habit of applying the grafts in rows. The object sought in this method of application is, the retention of the grafts in their place with the use of as little plaster as possible. I conceive this point to be very essential. When a large amount of plaster is used the ulcer is to a great extent

covered with it, and beneath this plaster accumulate the discharges; the plaster is very frequently raised from the grafts, and the grafts may be moved from the point on which they were originally applied. I am satisfied that this has frequently happened in cases where the grafts were applied irregularly on the surface of the ulcer. The regular application in a continued line obviates all this danger by diminishing the amount of plaster necessary to keep the grafts in their places. The direction of the line will depend necessarily on the shape of the ulcer, since the plaster is used to protect the grafts, and retain them where they were originally applied. I therefore desire the lines to traverse the ulcer in such a way as to make them as short as possible. Having placed one row of grafts on the surface of the ulcer at regular intervals of half an inch I now proceed to cover this with a strip of isinglass-plaster, somewhat wider than the grafts. The other grafts are now put on in the same manner, until the ulcer has been sufficiently grafted, after which I place a wet compress of sheet-lint over it, and then apply with moderate firmness a roller-bandage, and require it to be wet with water about every four hours. This dressing remains undisturbed for a period of forty-eight hours, when I remove the bandage, and compress with much care, lest I might displace the grafts, but the plaster is not disturbed. The transparent character of the plaster used enables me to see the changes which have taken place beneath it. The ulcer should now be carefully cleansed with water, and a similar dressing reapplied.

Whether the ulcer ought to be dressed daily or every second day, will depend on its condition; but the plaster should remain undisturbed for a period of six or eight days. The planting of normal germs, or what is more familiarly called skin-grafting, has been to me a subject of great interest, and I have spent much time in the study of this interesting and successful mode of healing ulcers. The more common mode of germ-planting consists in taking from any part of the patient's body a piece of healthy skin, which is then divided into many small pieces, and these small pieces, varying in size from the number four to number eight shot, are then placed on the surface of the ulcer. In watching the result of this

operation, I have frequently witnessed phenomena which, at that time, I think had not been explained. It is the rule to allow the grafts to remain undisturbed for several days, although after the first forty-eight hours I have usually removed the dressing daily, for the purpose of watching the progress and cleansing the ulcer. It often happened that *every trace* of the grafts so recently applied had entirely disappeared, or at least were not discernible to the unaided eye. This appearance was deceptive and not real. Within a few days there would appear on the site of each graft a grayish-white speck, which would rapidly increase in size, and serve as a new point of cicatrization. In what did these phenomena consist? The germ-theory gives me a satisfactory solution of the question. The formed material had undergone putrefactive solution, and the germinal matter, having found a soil congenial to its wants, had taken root, to bring forth a thousand-fold. The second method of germ-planting consists in removing the epidermic scales from some portion of the body — more frequently the thigh — which had been previously shaved to remove the fine hairs, after which the parts were scraped with a scalpel, and the scales collected on a piece of writing-paper, and these carefully distributed over the surface of the ulcer. The same phenomena were here observed as in the first method, although less satisfactory results on the ulcer were obtained. The third method consists in applying a fly-blister to some portion of the body — collecting the serum, transferring it to the ulcer, and retaining it in contact. Here, again, good results have been attained, for the reason that the serum contains living germinal matter. The chamois-skin was used for the same purpose; but its use in every instance proved to be a miserable failure, for the reason that the germinal matter in the old skins was dead, and that dead seed will not grow.

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